AGRICULTURAL
Research

U.S. Department of Agriculture / June 1961

HOW SURFACTANTS AFFECT HERBICIDES

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AGRICULTURAL Research

June 1961/Volume 9, No. 12

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Water Management

H_2O is probably the best known of all chemical formulas. Almost everywhere in the U.S. water is a matter of considerable concern. In some places there is too much, in other places too little.

Lack of an adequate and dependable water supply is holding back expansion of cities and industries, keeping down crop and livestock production. On the other hand, too much water often has similar effects. Spring floods occur fairly regularly in some areas of our country. Quite often valuable farm land is almost worthless because of excess water.

Much USDA research is concentrated on these two types of water difficulties. In arid or semiarid regions we're studying methods of recovering or saving water that normally is lost. We hope research will show us how we can increase irrigation efficiency by 50 percent or more.

Surface storage of water is valuable, but we must also continue studying methods of recharging underground aquifers as an aid to stabilizing water supply.

Reliable information is being sought on how surface sealing, soil compaction, and soil density influence infiltration of water. Such information is valuable for irrigation *and* for better understanding of drainage problems.

In some parts of the country there is need for basic information on how we can achieve better drainage and how we can relieve soil compaction. We are studying water intake rates and storage capacities of various soils.

Excess water problems also involve understanding the effects of modern tillage methods on water permeability of soil and soil structure.

The dynamics of wind are being studied to observe effects on soil moisture. Other research involves studies of existing moisture balance in various subsoils and the effect of land leveling on irrigation and water use.

Closely related to problems of water management is research for greater understanding of plant needs and uses.

Farmers, industry, and consumers suffer the consequences of failing to plan sound use and conservation of water.

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington 25, D.C. Printing has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is $1 in the U.S. and countries of the Postal Union, $1.50 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington 25, D.C.

AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

HOW SURFACTANTS AFFECT HERBICIDES

A weedkiller's activity may increase, decrease, or not be affected, depending on type and amount of each chemical in a mixture, and plant sprayed

■ Minor changes in the chemical structure or concentration of surfactants may dramatically influence the action of herbicidal sprays.

A single surfactant (surface-active agent) may increase, decrease, or not affect the action of herbicides, according to studies by ARS plant physiologists L. L. Jansen and W. C. Shaw.

For example, one surfactant (an alkyphenol ethylene oxide condensate) was used in a series of herbicidal sprays applied to corn as test plants. The agent increased the killing action of dalapon sevenfold and trebled amitrole activity, but didn't affect 2,4-D and DNBP.

On soybeans, the same surfactant doubled the action of dalapon and amitrole, and trebled the action of 2,4-D and DNBP.

In these experiments, sublethal amounts of herbicides were applied to plants so the comparative effects of surfactants could be measured. This research is continuing at USDA's Agricultural Research Center, Beltsville, Md.

Soaps, detergents, and shampoos are commonly used surfactants. In agriculture, similar compounds are used as sticking, spreading, and wetting agents.

Why do surfactants have such effects on herbicides? Scientists don't know all the answers. But they do know that when surfactants are used at concentrations which have the most influence on a herbicide's activity, there are few changes in sticking, spreading, or wetting abilities.

Slight changes in the chemical structure of a surfactant, however, greatly influence the properties the agent imparts to solutions. Changes occur, for instance, in the solution's ability to conduct electricity and in the relative degree of colloid aggregation (clumping of dispersed, but undissolved substances). Further research is needed to explore the significance of these changes on herbicidal action.

The effectiveness of surfactants used with weedkillers varies, depending on the type and amount of surfactant and herbicide, and the plant the spray mixture is applied to.

The scientists say an increase in the amount of surfactant used in a spray may significantly alter the weedkiller's effectiveness. At a concentration of one-hundredth of 1 percent, a surfactant usually doesn't increase herbicidal activity. But at one-tenth of 1 percent, the agent might depress activity; at 1 percent, it may significantly enhance activity.

More than 100 surfactants have been studied for their effects on herbicides. Although a few of the agents are

Turn Page

SURFACTANTS

(Continued)

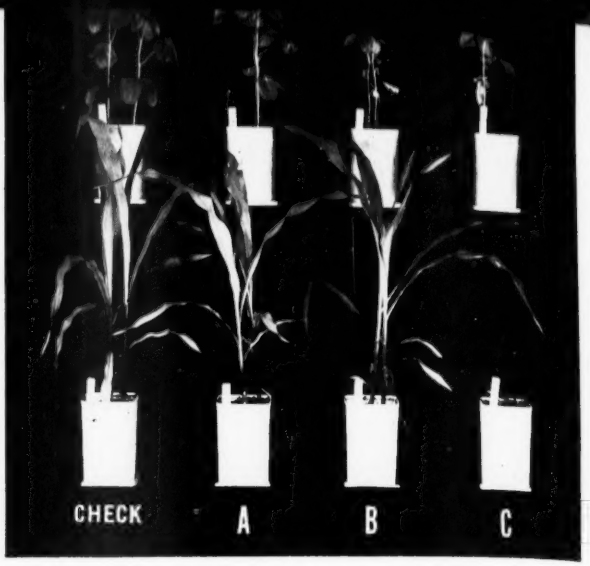
slightly toxic to plants, most are normally harmless to plants and animals.

The scientists believe surfactants might be used with weedkillers to fit specific crop-weed situations. For instance, an agent mixed with 2,4-D sharply increased the herbicide's activity on mustard without increasing its toxicity to corn plants and other grasses.

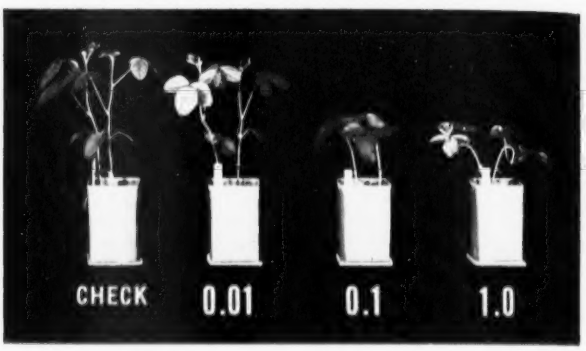
Improper use of a surfactant, however, could destroy a herbicide's selective action, increase injury to desirable plants, or decrease toxicity to weeds. So surfactants shouldn't be added to weedkillers without knowing their effects on the herbicides used.

Continuing studies are expected to uncover specific information that will indicate specialized uses for surfactant-herbicide combinations for selective weed control in crops.

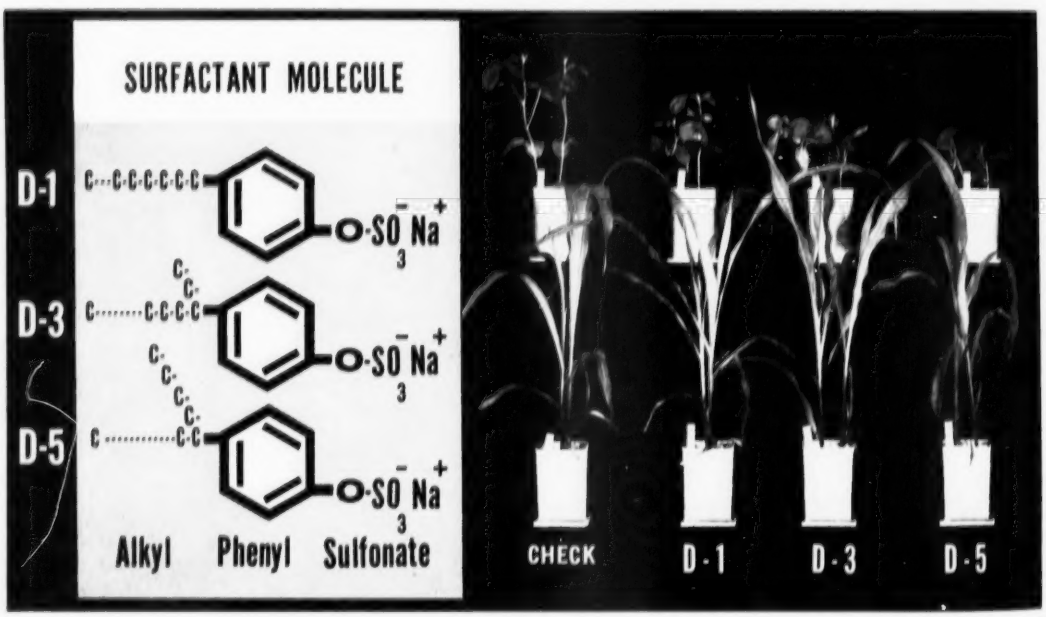
This research has many implications. If a smaller amount of herbicide with a surfactant controls weeds as efficiently as a greater amount without the surfactant, it may permit lower cost weed control. And herbicide residue hazards might be greatly reduced. Or surfactants might add to a weedkiller's effectiveness in combating weeds unusually difficult to control, without increasing toxic residues on desirable plants.



Corn and soybean plants (above) don't react alike to 1 percent concentration of surfactants A, B, C. Plants were sprayed with 2,4-D at rate of 1/16 pound per acre. Increasing strength of single surfactant (below) boosted 2,4-D activity on soybean plants.



Slight changes in structure of single surfactant, D, made DNBP—at ⅛ pound per acre—affect plants differently. Straight-chain alkyl group was attached to benzene ring at carbon atoms 1, 3, and 5 to produce the changes. Strength of surfactant was 1 percent in spray.



HELPFUL WASP GOES EAST

Larvae of the insect parasitize the alfalfa weevil, reducing populations of this pest

■ A helpful insect which parasitizes the destructive alfalfa weevil in the West is being released in several Eastern States.

This effort to establish a beneficial parasite (larvae of a ⅛-inch-long wasp) is aimed at eventually reducing alfalfa losses caused by the weevil.

In the past 10 years, the alfalfa weevil has become a serious pest of alfalfa in the East. Prior to 1951, the weevil was confined to Western States where the wasp (*Bathyplectes curculionis*) is present.

The adult wasp lays its eggs in weevil larvae. The eggs hatch into larvae that feed inside the host. After the host spins a cocoon, it is killed by the larval parasite.

Since most of the feeding on alfalfa is done by the weevil larvae, the parasite doesn't reduce the weevil's damage (mainly to first-cutting alfalfa) that year. Any benefit will come through reduced weevil populations the next year.

This wasp was brought from Europe to Utah in 1911. It isn't expected to produce immediate results in the East. Entomologists believe it will take the insect several years after it becomes established to spread throughout Eastern weevil-infested areas.

Experience in the West shows that the parasite will not produce dramatic results; weevil damage continues there even though the wasp is well established.

There is little hope of completely controlling the weevil by introducing the wasp. But if it becomes established, the number of weevils will be reduced. Nearly 90 percent of weevil larvae have been parasitized in some Western areas.

Efforts to establish the wasp in the East were started by ARS entomologists at the Parasite Introduction Station, Moorestown, N.J.

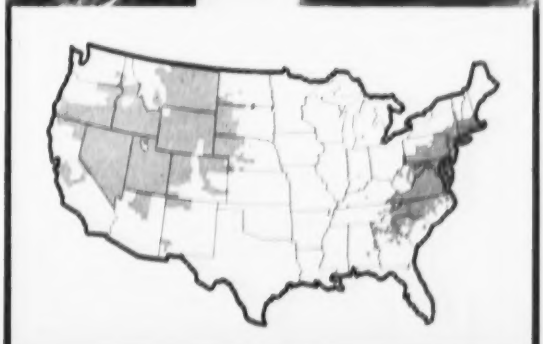
After being shipped from California in 1959, the insect was released in seven alfalfa fields in Delaware, New Jersey, and Virginia. Parasitized weevils were found a year later in all the fields, indicating the ability of the wasp to survive in the East. Wasps are now being released in other locations.

Although the parasite helps reduce future weevil populations, there are other ways to combat this alfalfa pest. Pesticides, such as malathion or methoxychlor, provide protection for alfalfa by killing weevil larvae while they are infesting the crop. Many larvae die from exposure to the sun's heat at the time the first alfalfa cutting is made.

Weevil-resistant varieties of alfalfa may be developed. Preliminary experiments are being conducted by State and USDA plant breeders and entomologists at Raleigh, N.C., and at the Agricultural Research Center, Beltsville, Md.

ARS entomologists have introduced other types of alfalfa weevil parasites from Europe. One species kills adult weevils; another parasitizes weevil eggs. However, there is no evidence that these parasites have become established in the U.S.☆

Beneficial wasp deposits eggs in alfalfa weevil larva. Eggs hatch into larvae within the host, then kill it. Weevil damage to alfalfa the following year will be lessened by reduction of the potential population available to infest an area. Parasite is being released in the East to help control the alfalfa weevil.



General areas of weevil infestation. Wasps are being released at 20 locations in New Jersey, Pennsylvania, Virginia, West Virginia, and North Carolina to get insect established in East.

Barley plant (left) shows the phytocidal effect of DDT on some varieties. Other plant was sprayed, resisted DDT.

Grow Barley from Hybrid Seed?

Success depends on finding a plant that has two genetic traits, male sterility and resistance to DDT, closely linked on one chromosome

■ A plan to make barley the third cereal crop—after corn and grain sorghum—grown from hybrid seed has been proposed by a USDA scientist.

It could mean a 25-percent increase in barley plant efficiency—about the same gain that hybrid vigor gave corn and sorghum.

Key to success is a barley plant—not yet discovered—in which two genetic traits are closely linked on one chromosome in the nucleus of each reproductive cell. These special traits—*male sterility* and *resistance to DDT insecticide*—occur naturally in some barley varieties.

A plant with the close linkage of these traits is being sought in USDA's world collection of barleys, and breeding research to get this linkage is also underway. Since both traits occur frequently in nature, chances of finding the plant are reasonably good, according to the originator of the plan, agronomist G. A. Wiebe. He is head of ARS barley research at USDA's Agricultural Research Center, Beltsville, Md.

An additional requirement for success of the plan is the development of mechanized production procedures. They are necessary because of the large amount of barley seed needed to plant each acre. About 25 million bushels (twice that needed for corn) are required annually for barley plantings in the U.S.

Assuming that a plant is found with good linkage of male sterility (expressed as *ms*) and DDT resistance (*ddt*), another preliminary step is required—choosing two varieties with outstanding agronomic characteristics that will combine well in the hybrids. One variety would serve as the female or seed parent of the hybrids—the other, the male parent.

Male-sterile barley flower (left) has stunted, aborted anthers that won't produce viable pollen. The other flower will self-pollinate.

Four steps are involved in the method

Wiebe outlines his proposed four-step breeding method this way:

1. Transfer traits by backcrossing into the barley chosen as female parent of the hybrids. This would be done by crossing the *ms-ddt* plant with the chosen variety. The resulting progeny would then be crossed back to the chosen variety a number of times. The object would be to re-establish the chosen variety with the additional *ms-ddt* trait.

2. Seed from the first and second generation of the last backcross would be sown in alternate rows. Seedlings in the second-generation rows only would be sprayed with DDT. This would kill all plants except those possessing *ms-ddt*. Surviving plants would be pollinated by plants in the unsprayed, first-generation rows. Only seed from the sprayed rows would be harvested.

3. Seed obtained in step 2 would be sown in rows. Seedlings in alternate rows would then be sprayed with DDT, giving a pure stand of *ms-ddt* plants. These plants would be pollinated by plants in the unsprayed

rows. Seed again would be harvested only from plants in the sprayed rows. The seed would be 50 percent *ms-ddt* the following year. This step would serve as the parent-seed-increase stage—providing the large amounts of seed needed for the production of hybrid seed.

4. Hybrid seed would be produced by sowing alternate rows with seed obtained in step 3 and with the variety chosen as the male parent. Seedlings in the rows from step-3 seed would be sprayed with DDT. All seed set on surviving *ms-ddt* plants would be hybrid seed and plants grown from it the next year would be fertile.

Since barley is normally self-pollinating, the degree to which the plants in alternate rows would cross-pollinate is unknown. It is expected that air currents would be sufficient to carry pollen from fertile to sterile plants.

Sterile male barleys were found in 1940

Male sterility was discovered in some barley varieties in 1940 by C. A. Suneson, ARS plant breeder stationed at the California Agricultural Experiment Station, Davis. Such barleys produce no pollen, but the female part of each plant is normal and will set seed when fertilized. Barley normally has male and female parts in each flower and is self-pollinating.

In 1959, British researcher J. D. Hayes at the Plant Breeding Station in Wales found that barley varieties display a differential response to DDT insecticide—some are killed and others resist the chemical.

Hybrid vigor—the phenomenon in which increased vigor is found in the progeny from a cross of plants differing in genetic constitution—has already been utilized successfully in corn, grain sorghum (AGR. RES., June 1954, p. 14), onions (AGR. RES., July 1954, p. 10), sugar beets, and other crops.☆

MICRONAIRE DETERMINES COTTON FIBER MATURITY

■ An improved technique for determining maturity of cotton fibers has been developed by ARS scientists.

They have shown that the Micronaire instrument can be substituted for the costly, time-consuming Causticaire test for measuring maturity of known varieties of cotton.

Analysis of Micronaire readings indicates high correlation with Causticaire determinations, according to cotton technologist W. E. Chapman at Mesilla Park, N. Mex.

Fiber maturity has an important effect on appearance of yarns and fabrics. Immature fibers contribute to formation of neps (tiny tangles), do not dye uniformly, and increase picker and card waste.

The Micronaire test measures the rate of air at a given pressure passing through a standard volume of cotton. The finer the fibers, the slower the air passes through them.

The Causticaire maturity test uses expensive instruments and chemicals—and takes more time than the Micronaire test.

Information from USDA's Agricultural Marketing Service provides data on Micronaire readings, Causticaire fineness, and Causticaire maturity for as many as 33 upland varieties and one American-Egyptian variety of cotton. This represents a total of 1,231 samples of upland cotton taken from various cotton-producing areas for 3 years.

The figures were used to compute mathematical relationships between fineness and maturity for each variety. Using such a formula, scientists can convert the Micronaire reading to the comparable Causticaire index of fiber maturity.

This means that fineness and maturity can be determined simply by interpreting readings taken at different air-flow rates while a single sample is in the Micronaire. Other ways to determine fiber maturity by measuring resistance to air flow have been developed. These methods, however, are complicated and require additional equipment.

A 1958 survey of 497 spinning plants showed 65 percent owned fineness-testing instruments. But only 15 percent owned maturity-testing instruments. Scientists interpreted this to be a result of the relative time and expense involved in performing the two tests, not an indication of the relative importance of the two properties.

ARS scientists expect that more firms will be able to determine the maturity of cotton, now that it has been shown that the Micronaire can provide this information.☆

Giraffe is headed for quarantine after passing health checkup aboard ship.

Inspector checks imported dog's pedigree at airport.

Workers disinfect feet, ensure against disease transmission.

Pigskins cleared for sealed transfer to approved processing plant.

On Guard Against LIVESTOCK FOES

Animal pests and diseases are kept out of the United States by about 100 veterinarians and inspectors; other agencies aid in this vital work

■ Protection against introduction of foreign livestock pests and diseases is the major function of USDA's animal inspection and quarantine system.

In protecting the Nation's livestock, approximately 100 ARS veterinarians and inspectors guard our borders and ports of entry.

Consider the magnitude of this small force's responsibilities. It must police not only importations of live animals, but also fresh or processed meats from abroad, which may harbor infectious organisms, and hides, wool, and other products, which may be contaminated. Greater overseas tourist travel heightens the likelihood of chance introductions.

Animal inspection and quarantine officials get help from several agencies in performing their vital work.

ARS plant quarantine inspectors aid by looking out for pests and diseases potentially dangerous to livestock. The

Meats and meat products arriving by mail without permit are intercepted by postal official, checked by USDA inspector.

Workers check identifying ear tag on animal being quarantined at the Clifton, N.J., station.

Imported cattle are tested for brucellosis and tuberculosis.

Airport customs official found pack of animal vaccine in baggage. USDA inspector checks. Zebras (below) are treated with insecticide mist.

U.S. Customs Service cooperates in baggage inspection; the U.S. Postal Service aids by intercepting suspect packages of animal materials. The Public Health Service, Immigration Service, and other Federal agencies also help in various ways.

Federal law provides for detention of imported cattle, horses, swine, sheep, poultry, and ruminants imported for zoo and exhibit purposes. Animals are kept long enough—usually 30 days—to establish their freedom from pests or diseases.

Animals entering the country at New York are detained at the USDA Animal Quarantine Station, Clifton, N.J. Importers may use other ports of entry but must provide their own quarantine facilities that are Federally approved. ARS veterinarians must inspect all quarantined stock.

Officials at the Clifton station maintain surveillance over all New York ship dockings, airport arrivals, postal introductions, and custom entries.

Almost 300,000 animals were inspected last year at all U.S. ports by animal inspection and quarantine veterinarians; about 19,000 animals were rejected for health reasons. Over 1 billion pounds of animal products were inspected at these ports during the year, and approximately 120,000 pounds of prohibited or restricted meats were seized and disposed of.

All animals entering the U.S. aren't quarantined. But all are inspected. Health certificates are often issued at countries of origin and honored by quarantine officials here upon shipment arrival. U.S. exports may be certified by our inspectors, thus avoiding delays upon arrival at foreign ports.

Shipments of potentially contaminated animal by-products are sometimes forwarded under Federal seal to approved commercial processing plants. At these plants the materials are treated to remove dangerous organisms.☆

Parasite Laboratory Aids Many

The world's largest specimen collection and reference index are used constantly

■ Quick identification of the African red tick, found in the U.S. for the first time last year, meant that eradication of this foreign livestock pest could start immediately.

The tick was identified by ARS parasitologist Allen McIntosh at USDA's Beltsville (Md.) Parasitological Laboratory. McIntosh says the job was easy because he had specimens of the tick in his collection of African parasites.

Helping to keep our country free of alien livestock pests is only one of the functions of this unique laboratory. As custodian of the world's most complete information on parasites affecting man and animals, it performs a vital service to parasitologists everywhere.

A. O. Foster, director, says the laboratory's collection of documented parasites and its Index-Catalogue of Medical and Veterinary Zoology are used constantly to answer questions on identification and distribution of parasites and methods for their control. These questions come from physicians, research workers, science students, quarantine and public health inspectors, military officials, and others concerned with human and animal health.

Scientists frequently come to the laboratory to study specimens in the parasite collection and to gather literature references. Specimens are occasionally loaned to other laboratories for limited periods.

The collection has served at times as a court of last resort in settling differences of opinion as to a parasite's identity. During World War II, the Index-Catalogue provided information on parasites likely to be found in areas where Allied troops were stationed. Both facilities are invaluable in helping to establish identity and place of origin of newly found parasites and in diagnosing parasitic diseases.

Collection began about 75 years ago

The parasite collection was started nearly 75 years ago by Albert Hassall, an English veterinarian, who brought his small private collection with him when he joined USDA. The collection now contains more than 60,000 lots of specimens, including several valuable collections donated by world-famous parasitologists.

The specimens range from 30-foot-long tapeworms to microscopic protozoa that live inside blood cells. Included are hookworms, liver flukes, nematodes, lice, ticks, and thousands of other parasitic organisms that prey on man and animals.

The collection is maintained by McIntosh, who also serves as consultant to the Index-Catalogue staff.

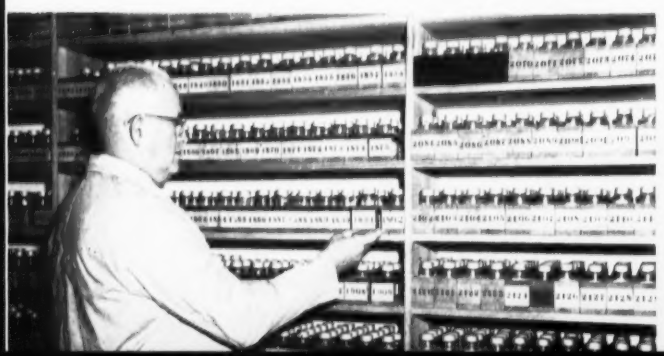
The Index-Catalogue was also begun by Hassall to supplement the parasite collection. Mildred Doss, parasitologist in charge, says the card file now contains more than 1½ million entries, representing 22,000 publications and 32 languages. It is estimated that about 90 percent of the world's literature on animal parasites is recorded in this index.

Reference materials are received on loan from 225 cooperating libraries, including the Library of Congress and the National Library of Medicine. Approximately 10,000 new references are added annually. Each reference is classified according to the author, parasite, species and subspecies, parasite's host, and antiparasite (treatment).

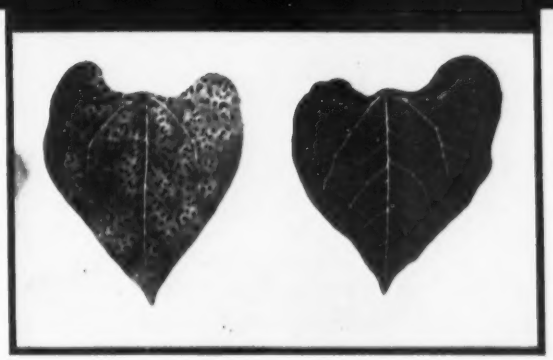
A limited edition of the *author* section of the Index-Catalogue has been printed in book form. This edition includes literature references through 1953. Since then, supplements have been issued annually. The copies are sent mainly to parasitology laboratories for use in research and regulatory work.

Director Foster says workers in about 70 countries have requested and received the author index. He hopes the complete Index-Catalogue can be published, so that its usefulness can be more fully realized. ☆

Parasites are given identifying numbers; makes it easy for McIntosh to find needed specimens.



Miss Doss adds card to Index-Catalogue, which has 1.5 million entries on parasite literature.



Bean leaf (right) was cured in 1 week by phleomycin. Rusted leaf wasn't treated.

Outstanding Results From Phleomycin

■ A new antibiotic—phleomycin—shows marked effectiveness under greenhouse conditions as a protectant and therapeutant against rust disease of snap beans.

This is the first reported use of the compound for plant-disease control. Phleomycin was isolated in 1956 by Japanese scientists in Tokyo. In their research, the antibiotic showed activity against organisms causing tuberculosis, pneumonia, typhus, dysentery, paratyphoid, and typhoid in humans, and anthrax of livestock.

Studies of phleomycin on plants are being made by pathologists B. C. Smale and M. D. Montgillion at the Agricultural Research Center, Beltsville, Md.

In greenhouse experiments, phleomycin protected bean plants from rust infection about 500 times more effectively than chemicals or antibiotics now used. And the compound cured rust-diseased plants several hundred times more effectively than any other antibiotic yet tested. At present there is no commercial therapeutant for bean rust.

An exceptionally low concentration of this antibiotic—1 ppm in water, sprayed on leaf surfaces—is sufficient for complete rust control, according to the ARS scientists. No phytotoxic effects from phleomycin were noted in their greenhouse experiments, in which solutions containing up to 90 ppm were used.

The exact chemical structure of phleomycin is not yet known. It is produced by a *Streptomyces*—a close relative of organisms that produce other antibiotics, such as streptomycin. Chemical analysis suggests that the antibiotic has the empirical formula $C_{55}H_{93}N_{17}O_{32}$ or $C_{55}H_{93}N_{17}O_{32}Cu$.

In the Japanese studies, removal of the copper atom did not change the antibiotic action of phleomycin.

The scientists at the Agricultural Research Center are continuing experiments to determine the antibiotic's effectiveness against other plant fungi, such as downy mildew, anthracnose, and other rusts.☆

ZINEB CONTROLS COTTON RUST

■ Zineb fungicide—used at the rate of 2 pounds in 40 gallons of water per acre—can effectively control rust fungus in Southwestern cotton, if applied before the plants become infected, say USDA and Arizona scientists.

This rust often flares into severe attacks, reducing cotton yields as much as 25 to 30 percent. Such large losses point up the need for satisfactory control in the Southwest. The frequency of destructive outbreaks has increased since 1950, along with the expansion of cotton production into newly developed areas.

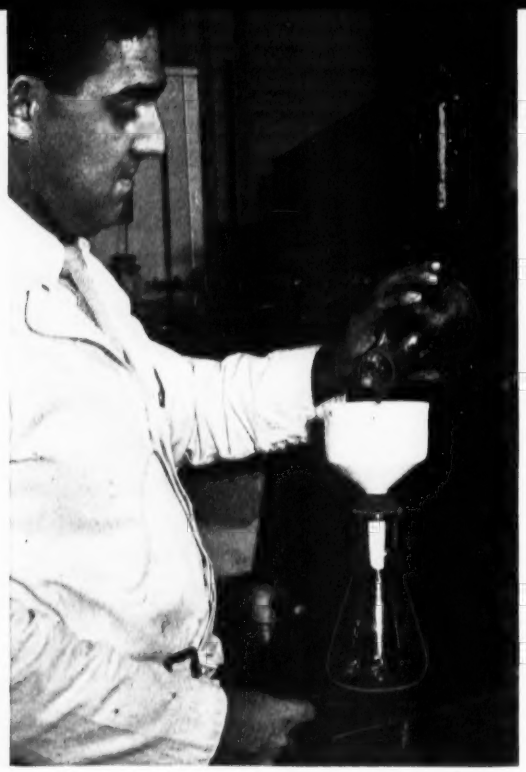
Rust spores infect and overwinter on an alternate host, grama grass. This grass grows abundantly on rangelands adjacent to the new cotton-growing areas. Good conditions exist for rust development wherever grama grass and cotton are in the same vicinity. Rainy weather in July and August creates moist conditions favoring the release of rust spores which infect the cotton.

Approximately 50 fungicides were tested in greenhouse and field experiments by scientists at the Cotton Research Center of the Arizona Agricultural Experiment Station, Tempe. The compounds were applied to cotton plants as sprays before and after exposure to rust spores from the grama grasses.

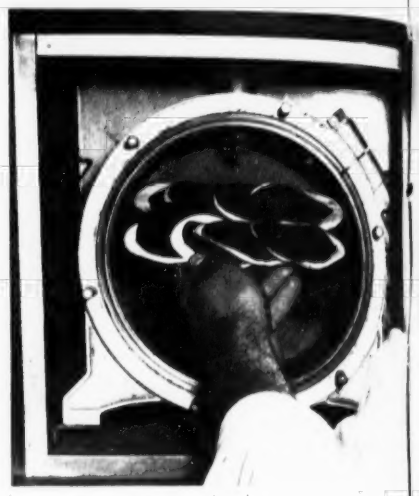
The most satisfactory control was observed in the zineb-treated plots receiving a per-acre dosage of 2 pounds of chemical in 40 gallons of water. Plants in these plots had few pustules, but many lesions were found on untreated plants.

The spray should be applied early in July, before the rainy season begins, and continued at 10- to 12-day intervals throughout the month, according to plant pathologists L. M. Blands of ARS and R. B. Streets of the Arizona station.

None of the fungicides tested (including zineb) will eradicate the fungus or alter its normal development once the rust is established in the cotton plant.☆

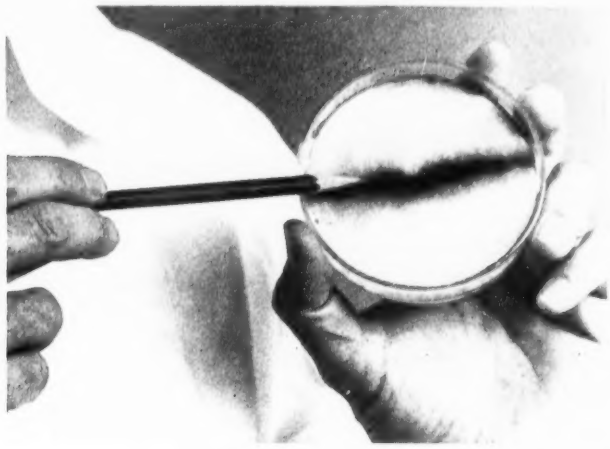


Alex Ciegler recovers beta-carotene (left) by filtering culture-produced material. This, in turn, is dried. Final product is orange filter cake or mat of solids. These contain, due to improvements, up to 1.7 percent of beta-carotene.



Yields of this vitamin A source were increased threefold and its practical storage life sixfold in laboratory studies

Improvements in the Beta-Carotene Process



Culture of plus and minus strains of mold that mate and produce the carotene by fermentation. Under surface of mating area (black zone), culture has typical orange color.

■ Trebled yields of beta-carotene in laboratory fermentations of agricultural products have been achieved by USDA scientists.

Solids yielded by the improved fermentation process can be added to livestock and poultry feeds as a potent, low-fiber source of vitamin A.

Yields have been increased from 0.5 percent of total solids (obtained in the process developed in 1957) to 1.7 percent, and storage life of the beta-carotene has been improved.

Major changes in the process—leading to the increased yields—include: (1) Using more efficient strains of a carotene-producing mold; and (2) adding a deodorized kerosene to the mold nutrient solution.

Addition of the deodorized kerosene to the culture medium gave a large increase in yield when used with molds that were efficient producers of beta-carotene.

The newest beta-carotene medium contains acid-hydrolyzed corn and soybean meal, animal fat and vegetable oil, emulsifier, the deodorized kerosene, vitamin B_1, and beta-ionone.

Improvements in the fermentation process, developed at the Northern utilization laboratory, Peoria, Ill., were made by microbiologist A. Cieg-

Improved process trebles yield of beta-carotene solids shown being dried in special vacuum oven.

ler, chemist G. E. N. Nelson, and bacteriologist H. H. Hall, head of the investigations.

A sixfold increase in the practical storage life of fermentation-produced beta-carotene was also obtained by two methods. In one, Ciegler added a preservative to the fermentation medium or to the dried solids. In another, the dried solids were suspended in vegetable oil for protection from oxidation.

Carotene occurs naturally as pigment

Carotene occurs naturally as an orange-yellow pigment in plant and animal tissue. It is extracted from plant sources or synthesized chemically and added to poultry and livestock feeds as a source of pigment and vitamin A, required by all animals. It is converted to the vitamin in the animal liver. Carotene is also used in pharmaceuticals and to color and enrich foods.

The first success in beta-carotene research came at Peoria in 1957 with the practical application of a technique for mating micro-organisms. Chemist R. F. Anderson and microbiologist G. W. Hesseltine found that certain strains of the mold *Blakeslea trispora* can be grown together to yield beta-carotene in proportions of dry matter that exceed the proportion in ordinary plant materials. The phenomenon of micro-organism mating had been reported earlier by the West Virginia Agricultural Experiment Station.

In the process at Peoria, the grain-based medium is fermented by the mated molds in aerated fermentors. The solids containing beta-carotene are harvested by filtration. Then the product is dried.☆

Promising New

Brucellosis Test

■ A new way of detecting bovine brucellosis—that shows promise as a supplemental test—has been developed by ARS scientists.

Called the Heat Inactivation Test (H.I.T.), this method was designed by veterinary microbiologist T. E. Amerault and associates at USDA's National Animal Disease Laboratory, Beltsville, Md.

While widespread use of this test under field conditions will be necessary before final evaluation can be made, research indicates that the primary value of the new test will be to supplement the standard tube and plate agglutination tests by clarifying the brucellosis status of cattle in problem herds.

Such herds are those few in which reactors or suspects are repeatedly found after continuous application of standard diagnostic tests and standard eradication and sanitary procedures. Although problem herds are not a recent development, they have become more apparent as the incidence of bovine brucellosis has been markedly decreased by the State-Federal brucellosis eradication program. Elimination of the cause of problem herds is necessary before eradication of bovine brucellosis from this country can be realized.

Brucellosis of cattle usually is caused by the bacterium *Brucella abortus*, and occasionally by *Br. suis* or *Br. melitensis*. The latter two are the principal causes of brucellosis of swine and goats, respectively. All three bacteria can cause brucellosis in man.

The new test must be made in a laboratory by trained personnel. The serum and antigen solutions used are the same as those used in the standard tube test for brucellosis.

In the new test, the serum-antigen mixture is heated in a water bath for 15 minutes at 65° C. (149° F.). The samples are cooled immediately to 18° C. (60° F.), centrifuged at 1,000 times gravity, decanted, resuspended in 0.85 percent sodium chloride solution, and examined for reaction. Any reaction in a 1 to 25 or higher dilution of serum is considered positive and a specific indication of infection.

To prove the efficiency of the new test method, samples of serum, milk, and other materials were obtained from 563 cattle. Of these, 410 were from naturally infected herds, 10 were from Brucella-free herds, and 143 were from a group of cattle artificially exposed to virulent *Brucella abortus*. The blood serums were tested by the H.I.T.

Milk, uterine material, and tissue samples (taken post-mortem) were examined in the laboratory for the presence of *Br. abortus*. Positive reactions to the test were given by all suspect and reactor cattle from which *Br. abortus* was isolated.

In no instance was this bacterium found in samples from cattle whose serums were negative to the test.☆

Conservation bench terraces (B) and conventional terraces (T) were compared in studies by ARS agricultural engineer V. L. Hauser. He finds that the bench terrace impounds more water, is most efficient.

CONSERVATION BENCHES INCREASE EFFICIENCY

More runoff spread on a larger area results in gains not obtained from the terraces generally used

Change in shape of the conventional terrace, use of level bench instead of narrow channel, results in additional water-saving.

■ Conservation bench terraces save more water on sloping farmland than terraces now in general use throughout the U.S.

Developed about 5 years ago, conservation bench terraces are already much used in Texas and Oklahoma—and are being adopted in other States.

Increased water conservation on sloping fields is made possible by changing the shape of conventional terraces. The lower part of each terrace interval is leveled lengthwise (made into a bench) on the contour of the slope so that water is retained and spread uniformly. A terrace ridge is built along the contour on the downhill side of each terrace interval to impound water on the level area. The ridges are curved up the slope at the end of each terrace to retain the water.

Conventional terraces now in general use on farms have ridges built along the contour of the slope. A relatively narrow channel is on the uphill side of each ridge. Runoff water must be absorbed by soil in this narrow channel.

The conservation bench may impound up to 6 inches of runoff water, according to ARS agricultural engineer V. L. Hauser, working at Bushland, Tex., in cooperation with the Texas Agricultural Experiment Station. (See AGR. RES., August 1958, p. 5.)

Because this system spreads water over a larger area than other methods, more runoff may be stored in the plant root zone. If excess water remains impounded, it may be drained into grass waterways at the ends of the conservation benches.

During Hauser's evaluations in 1960, 6.2 inches of rain fell during the week of June 5. This rainfall is 2.6 times the June average at Bushland.

Runoff water was impounded, spread evenly, and used efficiently on the level benches. In contrast, runoff impounded in the channels of conventional terraces was used less efficiently.

Grain sorghum produced a satisfactory stand in all terrace channels. However, heavy rain and runoff drowned seedlings in the conventional terraces. This water didn't hinder growth of seedlings on the level conservation benches.☆

Two new cigar-filler tobaccos

Two new tobaccos—the first cigar-filler varieties that resist wildfire or mosaic—have been released by USDA and the Pennsylvania Agricultural Experiment Station.

Pennbel-69 is highly resistant to wildfire and mosaic. Pennleaf-1 resists wildfire and has many of the desirable field and cured-leaf characteristics of standard cigar-filler varieties grown in Pennsylvania.

Each variety has a broader leaf type than Swarr-Hibshman—a standard cigar tobacco. In evaluations since 1951, both new varieties have produced high-quality tobacco.

Pennbel-69 produced higher average yields than Swarr-Hibshman in several years of testing.

Both tobacco varieties were developed by agronomists H. B. Engle of ARS and T. R. Terrill of the Pennsylvania station.

Limited quantities of seed are available to growers through the station's Foundation Seed Service. None is available from USDA.

Harvester adds speed and accuracy

A tractor-mounted harvester that improves speed and accuracy in grass-seed production studies has been developed for use in small plots.

ARS agronomist C. L. Canode and technician E. V. Horning, both working at Pullman, Wash., with the Washington Agricultural Experiment Stations, say use of this new harvester results in little loss of seed during cutting unless grass is severely lodged in more than one direction. Harvested grass can be bagged directly from the box on the harvester. Shattered seed is removed from the box by sweeping.

Two or three men can easily operate the harvester efficiently. One man drives the tractor and the others bag plant material. Three men can cut and bag 60 to 70 plots per hour, depending on the species of grass and the extent of lodging, the USDA researchers say.

Experimental grass seed plots normally are harvested by hand. By the time all plots are harvested, shattering may cause losses great enough to ruin the accuracy of the studies.

First nonbitter white sweetclover

Denta—our first nonbitter white sweetclover—has been developed and released by USDA and the Wisconsin Agricultural Experiment Station.

Another nonbitter sweetclover was developed in Canada last year.

Denta has only one-twentieth the coumarin found in other sweetclovers. Coumarin makes sweetclovers smell sweet but gives them a bitter taste unpalatable to most livestock.

Improperly cured or stored sweetclover hay or silage causes coumarin to decompose into dicumarol. When eaten by livestock, dicumarol causes an often fatal condition called sweetclover poisoning or bleeding disease. It is hoped that the low coumarin content of Denta will reduce this disease problem in livestock.

Denta has some resistance to blackstem and gooseneck—two serious fungus diseases of sweetclover.

The new variety is suitable for growth in the Northern Great Plains and the western area of the Cornbelt. Denta flowers about 3 to 4 weeks later than other white sweetclovers, is leafy, and has medium-sized stems. It recovers rapidly after clipping and can be used for pastures, hay, silage, or as a green manure crop.

Limited quantities of breeders' seed are being released to State experiment stations for foundation seed production. This seed will be available in 1962 to certified seed producers. Certified seed should be available for farm planting in 1963. No seed is available from USDA.

New way to dehydrate vegetables

A new means of dehydrating potato, carrot, or other vegetable pieces—so they can be made ready to eat by simmering in water for only about 5 minutes—is being developed by USDA utilization research engineers at Philadelphia, Pa.

Side-mounted cutter bar works at various heights. Floating lifters pick up lodged stems on either side of row. Reel places the plants, heads in rear, in box. Harvester increases speed and accuracy in experiments.

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The process gives vegetable pieces a porous structure, which enables them to take up water rapidly. This reduces their cooking time much below the 15 to 30 minutes that is usually required for preparing vegetable pieces.

According to information from the ARS Eastern utilization laboratory in Philadelphia, the method was improved by:

(1) Interrupting the drying process when the pieces would normally begin to harden and shrivel; (2) pressure-cooking them; and (3) suddenly releasing the pressure. This gives the pieces a porous structure before the final stages of drying.

The process has additional advantages. The final, more difficult drying can be done more rapidly than would otherwise be possible. Larger vegetable pieces can be dried by this process than by conventional means. The pieces resume their original shape and become tender and palatable after a few minutes in boiling water.

Researchers also report that excellent dehydrated diced carrots have been produced, and that progress is being made in adapting the process to potatoes. Work is also underway to adapt the process for use on other vegetables.

Weevils lived long in laboratory

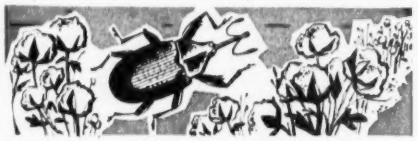
How old is an old boll weevil?

In a recent study conducted by ARS entomologists E. N. Lambremont and N. W. Earle, boll weevils lived a maximum of 199 days in a controlled laboratory environment. The study was made at Baton Rouge, La., in cooperation with the Louisiana Agricultural Experiment Station.

No information was available concerning the life span of boll weevils reared from the egg to the adult stage on an artificial diet. Data obtained in the study should help researchers evaluate results of various types of laboratory experiments with this insect.

In the study, adults of laboratory cultures of weevils from Mexico and Louisiana were put in an environment where temperature and humidity were controlled. The insects were fed fresh cotton squares (flower buds).

Ninth-generation boll weevil males from Mexico lived, on the average, about 120 days, but a few lived 199 days. Females averaged more than



80 days. Fifteenth-generation males and females from Louisiana averaged, respectively, 89 and 68 days of life.

Life spans varied among the weevils studied—according to sex of the insects, culture, and rearing conditions. The average life span of laboratory-reared insects generally exceeded those of boll weevils in the field. However, field records have been obtained of weevils living 383 days. These long-lived weevils entered hibernation in the fall, emerged in the spring, lived through the summer, and went back into hibernation the following fall.

Computers aid in tillage studies

A new use of analog computers is saving time and improving accuracy in USDA's tillage experiments.

Analog computers are electronic instruments used in various ways to perform complicated mathematical computations. Each of a number of units does one phase of the calculating, using electric signals.

The system immediately graphs the mathematical relationship of the factors tested. Thus, in a tillage test, the relationship between power and speed and depth of cut can be computed automatically by connecting units in proper sequence.

ARS agricultural engineers at the National Tillage Machinery Laboratory, Auburn, Ala., say this use of analog computers has three chief advantages: (1) Professional and subprofessional workers spend less time converting readings from individual charts into mathematical formulae (this used to take up to 6 months); (2) data are more accurate because small, inevitable errors in converting the readings are eliminated; and (3) engineers can quickly see results of their experiments.

They can repeat an experiment immediately when some obvious error has been made or when changing one of the conditions of the experiment will give more useful information.

U.S. GOVERNMENT PRINTING OFFICE: 1961